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ARTICLE X.—Notes on Species of North American Oligochaeta.
III. List of Species found in Illinois, and Descriptions
of Illinois Tubificidae. By FRANK SMITH.

The study of Illinois *Oligochaeta* has been mostly confined to collections of the Illinois State Laboratory of Natural History, made near the Biological Station at Havana, Ill., and in the vicinity of the University of Illinois, at Urbana; it is probable, therefore, that several species occur in the State which are not included in the following list. Thus far no attention has been given to the *Discodrilidae* and but little to the *Euchytraeidae* of the State.

A list of the earthworms found in North America was published in 1888 by Garman in Vol. III. of this Bulletin, in which those mentioned as occurring in Illinois are three species of *Lumbricidae*, one of *Acanthodrilidae*, and one of *Pericheta* which had become established in the University greenhouses. To these must now be added seven other species, most of which have been described since Garman's paper appeared.

The species recorded have all been identified by the writer, but a considerable part of the detailed study of sections of the two new species of *Tubificidae* here described has been made by a student of the University of Illinois, Miss Ella V. Engstrom, whose careful work has been of material assistance in the preparation of this paper. The drawings for the figures were made by Miss Lydia M. Hart, Artist of the Illinois State Laboratory of Natural History.

LIST OF SPECIES.¹

Lumbricidae.

- Lumbricus herculeus* Savigny. Urbana; infrequent.
- Allolobophora fetida* Savigny. Urbana; abundant.
- Allolobophora rosea* Savigny.² Urbana; frequent.
- Allolobophora profuga* Rosa. Urbana; abundant.

¹ The classification of families is that adopted by Beddard in his Monograph.
² *A. mucosa* Eisen.

Allolobophora caliginosa trapezoides Dugès.¹ Urbana and Havana; abundant.

Allolobophora sp.² Urbana and Havana; frequent.

Geoscolicidae.

Sparganophilus eiseni Smith. Urbana and Havana; abundant.

Acanthodrilidae.

Diplocardia communis Garman. Urbana; abundant.

Diplocardia riparia Smith. Havana; abundant.

Diplocardia singularis Ude. Urbana and Havana; frequent.

Diplocardia sp.³ Havana; frequent.

Lumbriculidae.

Thinodrilus inconstans Smith. Havana; abundant.

Mesoporodrilus asymmetricus Smith. Havana; infrequent.

Phreoryctidae.

Phreoryctes emissarius Forbes. Urbana, infrequent; Havana, abundant.

Euchytræidae.

Fridericia agilis Smith. Havana; abundant.

Tubificidae.

Tubifer vicolorum Lamarck. Urbana and Havana; abundant.

Limnodrilus clapedianus Ratzel. Urbana and Havana; abundant.

¹ *A. turgida* Garman, non Eisen.

² A species closely allied to *A. giesleri* Ude, but its exact relationship has not yet been determined.

³ A species closely allied to *D. verrucosa* Ude. Exact relationship not yet determined.

Rhizodrilus lacteus n. g. et n. sp. Havana; abundant locally.

Embolopcephalus multisetosus n. sp. Havana; abundant locally.

Naidomorpha.¹

Nais lacustris Linnaeus. Urbana and Havana; abundant.

Nais clinguis O. F. Müller. Urbana and Havana; abundant.

Nais lurida Timm. Havana; frequent.

Nais serpentina O. F. Müller. Havana; frequent.

Dero limosa Leydig. Havana; abundant.

Dero obtusa D'Udekem. Havana; abundant.

Dero vaga Leydig. Havana; abundant.

Dero furecata Oken. Havana; frequent.

Pristina leidy Smith. Havana; abundant.

Pristina flagellum Leydig. Havana; one specimen.

Chaetogaster limnæi v. Baer. Havana; abundant.

Chaetogaster diaphanus Gruithuisen. Urbana and Havana; abundant.

Chaetogaster diastrophus Gruithuisen. Havana; abundant.

Eolosomatidae.

Eolosoma henprichii Ehrenberg. Urbana and Havana; frequent.

Eolosoma tenebrarum Vejdovsky. Havana; abundant.

Eolosoma sp.² Havana; abundant.

DESCRIPTIONS OF TUBIFICIDÆ.

As the first two species of *Tubificidæ* in our list are well-known European forms which have been described at length by previous writers, a brief recapitulation of some of their more important characters will suffice in this connection.

¹ But little attention has been given to the *Naidomorpha* of Urbana.

² A species with colorless integumental globules, not yet described.

Tubificer ricolorum Lamarek.

Length 25-50 mm.; number of somites 50-60. Dorsal bundles with three kinds of setae: capilliform setae, four or five per bundle anterior to clitellum, decreasing in number posteriorly and absent from the last few somites; pectinate setae, in somites anterior to the clitellum; and uncinata setae in other regions. Ventral bundles with four or five uncinata setae in anterior part and fewer posteriorly. In Illinois specimens the ventral bundles sometimes contain pectinate setae. No ventral setae on XI. Clitellum on XI and most of XII. Alimentary tract spiral-like in appearance, but with dorsal vessel on the upper side throughout its course. One pair of "hearts" in VIII. First nephridium in VII. Penis with a very short delicate chitinous sheath near tip.

Limnodrilus claparedianus Ratzel.

Length 40-70 mm.; number of somites 145-160. Setae all uncinata; five to seven per bundle in anterior part, fewer posteriorly. Clitellum on XI and XII. "Hearts" in VIII. Penis with chitinous sheath .5-1 mm. in length, which is twenty to thirty times its diameter.

Rhizodrilus lacteus n. g. et n. sp.

The species bearing this name is fairly abundant in Flag Lake, one of the larger bodies of water occurring in the bottom-lands of the Illinois River near Havana, Ill. Nothing is known of its distribution in other regions. Specimens have been found in considerable numbers among the roots of submerged or partially submerged *Sagittaria variabilis*, but thus far in no other situation. They are sexually mature in July.

The worm is rather sluggish in habit, and the body is usually contorted and in an almost inextricable tangle. It varies from 70 to 100 mm. in length in sexually mature individuals; is quite slender, varying from .4 to .6 mm. in diameter; and is largest in the region of the reproductive organs. The body is nearly white, owing to the great number

of coelomic corpuscles with which the coelomic fluid is crowded, and which are readily visible through the delicate walls. In nine specimens, apparently complete, the number of somites varies from 215 to 365, the average number being 281.

The setae, except the genital ones, are all of the ordinary uncinata, or cleft, type, and have the usual arrangement of four bundles to each somite. Anterior to the clitellum the number of setae in each bundle is usually five or six, but posterior to it, throughout the greater part of the length, the number is commonly four, while near the posterior end it is more frequently one to three. The ordinary uncinata setae are slightly enlarged at a point about one third of their length from the outer extremity. They are usually .09 to .1 mm. in length and about .005 mm. in diameter at the middle. The genital setae are of two kinds. On the ventral side of IX, in place of each bundle of ordinary setae, there is a specially modified seta (Pl. XXXIX., Fig. 4, b, and Pl. XL., Fig. 6—viewed in different planes) .12 mm. in length and about .01 mm. in diameter at its largest part, which is near the proximal end. These setae are in close relation to the openings of a pair of glands to be described later. In one specimen ventral setae of the same sort were present in X. The ventral bundles of XI each consist of four to six peculiarly shaped setae entirely different from the ventral setae of IX, the outer end of each being spatulate and rather abruptly bent (Fig. 4, c). These setae are from .14 to .16 mm. in length, and the diameter is about .009 mm. at the inner end and .006 mm. near the expanded outer end, while the outer end itself is about .01 mm. in width.

The clitellum is of the same general character as the clitellum present in other *Tubificidae*, and extends from about the middle of X to the posterior part of XII, in some individuals encroaching on XIII. It is incomplete ventrally. The prostomium is relatively large and subconical.

The brain has a slightly convex anterior margin, without any such median anterior extension as is present in some *Tubificidae*. There are two posterior lobes extending backwards, one from each side of the middle of the ventral margin.

The pharynx extends through somites II and III, and its dorsal and ventral walls are of about equal thickness. The œsophagus extends backwards into VI, where the epithelium gradually assumes the character of that of the intestine. In VII the alimentary tract increases in diameter, and the intestine may be regarded as commencing in that somite. Septal glands are present in IV and V, those of the latter somite being the smaller. Cœlomic corpuscles are very numerous in the cœlomic spaces not otherwise filled. They are spherical and mostly without granular contents, although some contain a few rather large spherical granular bodies.

The circulatory system cannot be studied in the living worm because of the opacity due to the numerous corpuscles, and our knowledge of it is chiefly derived from a study of transverse and longitudinal sections. The dorsal and ventral vessels do not divide in the anterior region of the body to form supra- and sub-intestinal trunks. In the posterior part of each of somites VII-X a pair of large lateral vessels, or "hearts," is present, connecting the dorsal and ventral vessels directly, without giving off branches to the body wall as is the case in *Ilyodrilus*. These vessels are approximately equal in the somites mentioned. The diameter of the lateral vessels of VI is only about one fifth as great as that of the corresponding vessels of VII.

The nephridia have been studied with reference to character and arrangement in but three individuals, and in these only in the anterior twenty somites. These organs first appear in VIII, but in VIII, IX, and somites posterior to XI only one nephridium is present in each somite, and that is in the left side of the body in all cases observed. In sexually mature individuals nephridia are absent in X and XI. The ventral vessel lies in the left side of the body, and is closely invested by the expanded glandular part of each nephridium, the relation between them being much like that described by Goodrich as existing in *Vermiculus pilosus* ('95, p. 258). The nephridium enlarges almost immediately behind the anterior septum, forming a mass of considerable size, through which the duct passes in a tortuous course, finally leaving the

main mass at a point a little anterior to the middle and extending to the body wall in a latero-ventral and posterior direction, opening a little anterior to the inner margin of the ventral bundle. Absence of nephridia from one side of the body in several successive somites has been frequently observed in *Naidomorpha* (Benham, '93, p. 385, and Smith, '96, p. 398) and occasionally in the *Tubificidae* (Stole, '88, p. 23). In nearly all the species of *Tubificidae* studied by this latter observer he found rare cases in which one of the nephridia of some somites was entirely degenerate, and others in which a whole row of nephridia on one side, especially in the last somites, was less developed than the row of the other side. In *Rhizodrilus lacteus* this degeneration has gone still further, so that a row of nephridia on one side is entirely wanting.

The testes are in the anterior part of X, in the usual position, and the spermiducal funnels are in the posterior part of this somite, the sperm-ducts leading from them into XI and opening on its ventral side. Following the sperm-duct backwards from the point of entrance into XI, it is at first of small diameter, with relatively thin walls, and extends posteriorly and somewhat ventrally for a distance equal to one sixth the length of the somite. Bending then abruptly toward the dorsal side of the somite it passes directly upward to the dorsal wall, and then extends in a posterior direction to a point slightly beyond the middle of the somite, where it bends toward the ventral side, opening on the antero-lateral wall of a spermiducal chamber into which opens also the sperm-duct of the other side. (Pl. XXXIX., Fig. 5.) From the point at which the sperm-duct bends towards the dorsal wall throughout the rest of its course the lumen remains of small diameter. From this same point on, for nearly its whole length, the walls are greatly thickened, so that the diameter of the duct is nearly one third that of the entire somite. A short distance from the spermiducal pore the walls become thin again. There is no enlargement of the lumen to form an atrium, nor any modification of the wall in any special region to form a prostate gland, nor is there a penis. The great diameter of the duct throughout most of its length is

due to the glandular peritoneal layer which is formed of much-elongated cells.

The spermiducal chamber, already mentioned, is formed by an invagination of the mid-ventral wall of XI posterior to the middle of the somite. Its lateral walls are connected with the body wall by muscular strands which control their movements. When the form of this chamber is normal the innermost part is transversely elongated, and the outer part has its greatest length parallel with the long axis of the body; but at times the lateral walls may be pulled far apart, the chamber thus becoming merely a ventral depression. It seems probable, therefore, that the structures are chiefly functional during copulation. The wall of the chamber includes a cuticula, continuous with that of the body wall, a layer of hypodermis but slightly modified, and a layer beneath the hypodermis which is quite thick and includes many large cells, perhaps of a glandular nature, the contents of which are usually nearly transparent, though sometimes of a granular character. The peculiar genital setæ already referred to as constituting the ventral bundles of XI are borne on the posterior wall of the spermiducal chamber, into which they project.

But one sperm-sac is present. It extends from its opening in the dorsal part of septum X/XI into XV or XVI. In the somites posterior to XI it is included in the ovisac. The anterior septum of X is sometimes pushed far forward into IX, but there is no anterior sperm-sac.

Ovaries are present in the usual situation, in the anterior part of XI. The oviducal funnels and oviducts are small but fully developed, and situated between XI and XII. The single ovisac extends backwards from its opening in the dorsal part of septum XI/XII into XVII or XVIII. The ova develop in the same manner as in the majority of the *Tubificidae*, and not as in *Hyodrilus* and *Naidomorpha*.

Two spermathecae are present in the anterior part of X. Each of them has a sac, nearly spherical in outline, which communicates with the exterior through a short duct (Pl. XL, Fig. 7) opening on the anterior margin of X at a point

dorsad of a line connecting the ventral bundles of one side. The interval between the two spermathecal pores is about one fourth of the circumference of the body. The spermatozoa in the spermathecae are present in loose masses. No signs of spermatophores have as yet been found.

A pair of elongate tubular glands is present in IX, their openings being in close relation to the peculiar genital setae of that somite (Pl. XL., Fig. 6). In the specimen previously referred to as having genital setae on X similar to those on IX, a pair of such glands is also present in X, having similar relations to the setae of the somite. These glands are about equal in length to the somite, and their diameter, which is nearly uniform throughout their length, is about one eighth the diameter of the somite. The diameter of the lumen is about .01 mm. and the walls are .03 mm. in thickness. The wall consists of two layers of cells, the outermost being very thin and composed of flattened epithelial cells, while the inner layer is formed of relatively large glandular cells, largest at their distal ends, in which the nucleus is commonly situated. The openings of these glands and the associated setae are on prominent rounded elevations of the ventral wall of the somite (Pl. XL., Fig. 6) and in line with the ventral setae of adjacent somites. On the summit of these elevations the hypodermis is modified as it is in the genital papillae of some earthworms; for example, *Diplocardia* and *Allolobophora*.

For the sake of greater convenience in the comparison of *R. lactens* with other forms I give the following summary of its more important characters:

The number of somites is 215-365.

All the setae are unciniate except the genital ones, which are of two kinds, one form in IX and the other in XI.

The clitellum extends from the middle of X to the posterior part of XII.

Cœlomic corpuscles are very numerous.

Supra- and sub-intestinal vessels are wanting, and the lateral vessels or "hearts," which connect the dorsal and ventral vessels in VII-X, are enlarged, nearly uniform in size, and do not give off branches to the body wall.

The nephridia closely invest the ventral vessel, and, so far as observed, but one nephridium is contained in a somite.

The sperm-ducts have no prostate gland, atrium, or penis, and open into a median spermiducal chamber on the ventral side of XI.

A pair of spermathecae is present in the anterior part of X, and the spermathecal pores are a considerable distance from each other.

A pair of elongated tubular glands is present in IX, opening in close relation with the genital setae of that somite.

No attempt has been made to distinguish between generic and specific characters, since only one species of the genus is known. From the foregoing it is apparent that *Rhizodrilus lacteus* is somewhat closely related to *Lumbriculus spiralis* of Leidy ('52a, p. 285) in respect to length, number of somites, form and character of setae, color, and habits; but as Leidy's description is entirely inadequate for the purpose of identification, and as he left no type specimens of his species, the relationship between the two forms cannot be determined. It is unfortunate that the description of a new species of *Tubificidae* so frequently involves the description of a new genus, but according to present ideas of the classification of this family the character of the species under discussion will not permit its inclusion in any existing genus. The presence of two distinct kinds of highly modified genital setae and the presence of such setae in the ninth somite distinguish this worm from all other described forms of *Tubificidae*. In the absence of distinct prostate glands and in the presence of a common spermiducal chamber it differs from most *Tubificidae* but resembles *Vermiculus*. There is a further resemblance to the latter genus in the simplicity of the longitudinal blood-vessels and in the absence of both supra- and sub-intestinal vessels, but the relation of the lateral vessels of the anterior somites to other parts is very different in the two genera. In *Vermiculus pilosus*, in II-X there is no direct communication between the dorsal and ventral vessels, the single pair of branches of the dorsal vessel in each of those somites breaking up into a capillary network in the body wall, from which

the blood is conducted to the ventral vessel through two pairs of vessels in each somite, of which the posterior pair is the larger. In *V. limosus*, recently described from Japan by Hatai ('98, p. 110), the same general relation exists between these lateral vessels and the body wall, except that there is but one pair of lateral branches of the ventral vessel in each of the somites referred to, and that there is a slight difference in the number of somites in which such vessels occur. Goodrich ('95, p. 262) regarded this condition of the circulatory system as distinguishing *Vermiculus* from all other *Tubificide*. The circulatory system of *Ilyodrilus coccineus*, as described and figured by Stole ('88, p. 15, Tab. II., Fig. 9), seems to constitute a very interesting intermediate type between that of *Vermiculus* and such forms as *Rhizodrilus*. As Stole's paper is unfortunately written in Czech, it has been inaccessible to most students of the *Oligochæta*. Through Mr. L. F. Miskovsky, of Oberlin College, I have been so fortunate as to obtain a very careful translation of this admirable paper, and quote here that part which treats of the vascular arches of *Ilyodrilus*.

"In the following segments, i. e., in the fourth to the ninth inclusive, the dorsal artery is united with the ventral always through one pair only of lateral arteries, which issue before the posterior septum of each somite from the dorsal artery and gradually swell behind until in the last three of the named segments they assume the largest proportions, resembling thus the swelled lateral arteries (so-called hearts) which are found in the remaining genera of the *Tubificida*. The lateral arteries here described do not, however, open simply into the ventral artery. Each one of the lateral arteries approaches closely to the lateral diameter of the body and sends several branches into the integument. The branches running through the integument form in each segment an elegant vascular network which is connected through numerous anastomoses with the plexuses of the other segments. The sanguineous fluid after coursing through this integumentary network returns into the ventral vein through two special veins, which, issuing out of the integument from the lateral

diameter of the body, after a short course, empty into the ventral vein."

Figure 9 of Plate II in Stole's paper is a diagrammatic representation of the circulatory system in the anterior part of *I. coccineus*. Through some typographical error that part of the description of plates dealing with this figure is headed *Bothrioneuron vejtdorskyanum*, and is thus somewhat confusing. A comparison of this figure with that of the corresponding organs of *Vermiculus pilosus* (Goodrich '95, Pl. XXVI., Fig. 5) and *Rhizodrilus lacteus* (Pl. XL., Fig. 8) will readily suggest a common derivation for the different types. For convenience in making such comparison Figures 9 and 10 of Plate XL. have been prepared from the figures by Goodrich and Stole.

Embolocephalus multisetosus n. sp.

Worms of a species of *Tubificidae* not hitherto described are found in great abundance in the vegetable débris at the bottom of Flag Lake, and are occasionally met with in the vegetation along the banks of the Illinois River and the bottom-land lakes in the vicinity of Havana.

Well-extended individuals are 19 to 35 mm. in length. At the time of sexual activity a few somites at the anterior end, including the reproductive organs, are much enlarged, the diameter of the worm in this region being then two and a half or three times that of the remainder of the worm. In a rather large specimen the diameter in the region of the tenth somite is .8 mm., that of the middle of the worm is .3 mm., and at a distance from the posterior end equal to one fourth the length of the body the diameter is .2 mm. The number of somites varies from 49 to 106 in specimens examined, but 75 to 80 is more common. The main part of the body is of a dark grayish color, but the posterior end is lighter and less opaque. A sheath formed in part of foreign particles cemented together envelops the anterior part of the body, making it quite opaque. It adheres very closely to the surface of the worm and is removed with great difficulty. It is wanting in the posterior part of the body, which is extended into the open water and

is, as in many *Tubificidae*, the principal respiratory region. Non-retractile sense papillæ similar to those described for *Embolecephalus*, *Spirosperma*, and a few other *Tubificidae*, are present in this species. They are arranged in two rows on each somite, one row coinciding with that of the setæ bundles of the somite, and the other one being usually in the plane of the septum (Pl. XXXIX., Fig. 1). A few papillæ representing a third, very incomplete, row are often present.

When a specimen is examined with a lens, one is strongly reminded of some of the marine annelids by the dense clusters of elongated setæ in the dorsal bundles. The dorsal setæ are of two kinds; long capilliform setæ, often .5 mm. in length, and palmate or comb-like setæ .16 to .18 mm. in length (Pl. XXXIX., Fig. 2, c, d.). In the anterior bundles capilliform setæ vary in number from three to fourteen per bundle. Throughout most of the remainder of the body the number is but one to three per bundle, while the last ten to twenty somites usually have no dorsal setæ whatever. The palmate setæ are regularly found in only a few anterior somites, where the number varies from one to five per bundle. In the dorsal bundles of the greater part of the body back of the first ten or twelve somites, palmate setæ are usually lacking, though occasionally one such may be found in one or more bundles posterior to the middle of the worm. The relative number of capilliform setæ and palmate setæ per bundle is extremely variable. Some individuals have setæ of the two kinds in equal numbers, while others having a relatively large number of capilliform setæ have only one to three palmate setæ per bundle. Ventral setæ, usually two in each bundle, are present in all the somites except the first, eleventh, and last. They are sigmoid, uncinatè, and slightly enlarged at a distance from the distal end about equal to one third the length of the setæ. The ventral setæ of the anterior region are longer and less strongly curved than those of the posterior part of the body (Pl. XXXIX., Fig. 2, a, b).

There is no well-developed clitellum on any of the specimens in our collection, none of which seem to be at the height of sexual activity, but in a few individuals the

hypodermis of XI is slightly modified. The prostomium and anterior somite are very sensitive and thin-walled, and at the slightest irritation are so retracted that the first setigerous somite seems to form the end of the worm.

The brain is concave posteriorly, and its anterior part is prolonged into a process on each side of the median line. The alimentary tract has no special features distinguishing it from other *Tubificidae*. The pharynx occupies somite II and part of III; the wall of the dorsal side is somewhat thicker than that of the ventral side; the transition from the oesophagus to the intestine is gradual; and chlorogogue cells appear rather abruptly in the anterior part of VI. The inner epithelium becomes like that of the intestine in the posterior part of VI, while the diameter of the alimentary tract becomes considerably enlarged in VII. Posterior to this somite there is no great change in the diameter of the intestine or in the character of its walls. The coelomic corpuscles are very few in number and of irregular form.

The circulatory system cannot be studied in the living specimens, and it has proved an especially difficult task to work out its anatomy from sections. One pair of "hearts" is present in VIII, and in one specimen examined there were additional lateral vessels nearly as large in IX. The "hearts" communicate with the dorsal vessel, and no traces of a supra- or sub-intestinal vessel have been found. Anterior and posterior to the region of the reproductive organs the alimentary tract is invested by an extensive system of blood sinuses connected by a median ventral sinus or vessel, which, however, seems to have no direct connection with the ventral vessel nor to have the relations of a sub-intestinal vessel.

Paired nephridia are present in VII-IX, wanting in X-XIII, and begin again in XIV. The nephridiopores are in line with the ventral setae and a short distance in front of them.

The reproductive organs are similar in structure and arrangement to those of many other *Tubificidae*. The testes, spermathecae, and spermiducal funnels are in X, and the ovaries, sperm-ducts, and spermiducal glands in XI, on which somite are the spermiducal pores. The sperm-duct

is somewhat elongated and occasionally protrudes backward into the sperm-sac as far as the posterior part of XII. The diameter of that part of the duct nearest the funnel is very small (.01mm.), and that of its lumen not over .003 mm. The diameters of duct and lumen both gradually increase as the spermiducal gland is approached, and the course of the duct becomes more tortuous. That part of the duct to which the spermiducal gland is attached is expanded into an elongated chamber or "atrium" (Pl. XXXIX., Fig. 3), of which the diameter is about .05 mm., that of its lumen being .025 mm. Between the spermiducal gland and the pore the sperm-duct is about .03 mm. in diameter where smallest. The duct terminates in a protrusible penis, which is destitute of a chitinous sheath. The spermiducal pores are in line with the ventral setæ of adjacent somites, and also with that row of papillæ which is associated with the setæ. As before stated, there are no ventral setæ on XI. There are two median sperm-sacs, lying dorsad of the alimentary tract; an anterior one in IX, and a posterior one in XI-XIV. In some cases the latter extends into XV.

One pair of spermathecae is present in X, and in one of the sectioned specimens there is an additional spermatheca in the right side of IX, which is similar in every way to those of X except that it is slightly smaller. In the specimens examined none of the spermathecae contained any traces of spermatophores. The spermathecal duct is nearly uniform in diameter, and its length is one and a half to two times as great as the diameter of the sac. In each case observed the sac appeared like a hollow sphere with a broad invagination of one side, but whether or not this collapsed appearance is the normal one has not been determined. There seems to be no difference in the character of the wall in the different parts of the sac, and no glands have been found in connection with the spermathecal duct. The male organs are well developed in all the sectioned specimens studied, but the ovaries have not contained large ova, nor have there been any traces of ovisacs or oviducts. These specimens were collected in October, and the height of sexual activity is probably attained at some other time of the year.

The relation of the species under consideration to other *Tubificidae* cannot be finally determined in the light of our present knowledge of the anatomy of this species and of nearly related forms. In the presence of prominent non-retractile papillæ it resembles *Peloscolex*, *Spirosperma*, *Hemitubificæ*, and *Embolocephalus*. It probably is closely allied to Leidy's *Peloscolex variegatus* ('52, p. 124), but the meager description of that form and the lack of type specimens make it impossible to determine this point. The absence of a chitinous sheath about the penis distinguishes it from *Spirosperma* and *Hemitubificæ*, but there are no characters given in the description of *Embolocephalus* Randolph ('93, p. 472), which exclude it from that genus. The description includes, however, no account of the circulatory system in the anterior part of the worm nor any statement as to the presence or absence of a chitinous penis sheath. Sections of *E. plicatus* kindly sent me by Dr. Randolph furnish no evidence of the presence of this sheath in that species, but as they include none of the first eight somites it is impossible to compare the anatomy of the circulatory systems of the two species in that region. In view of the above facts I have included the Illinois species in the genus *Embolocephalus*, giving it the species name *multisetosus*. It differs from *E. velutinus* in having two kinds of dorsal setæ; and from *E. plicatus* in having palmate setæ in the dorsal bundles, and in other particulars as follows: (1) In *plicatus* the dorsal bundles are said to contain usually but six capilliform setæ and three uncinæ ones, and no statement is made to indicate that there is any considerable variability in the number in different regions of the body. In *multisetosus*, however, the dorsal bundles of the anterior region each contain from eight to sixteen setæ, while in the middle of the body the number is much smaller, and the posterior somites usually have no dorsal setæ whatever. (2) The papillæ of *plicatus* are in two rows, equally distant from the septa, while in *multisetosus* one row is in the plane of the setæ and the other in the plane of the septa. The papillæ of *multisetosus* are also much larger and more conspicuous than those of *plicatus*. (3) The diameter of the lumen of the sperm-duct of *plicatus* is nearly uniform throughout, while that of *multisetosus* is several times greater in the region of the atrium than elsewhere.

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EXPLANATION OF PLATES.

ABBREVIATIONS.

<i>at.</i> , atrium.	<i>n. c.</i> , nerve cord.
<i>clit.</i> , clitellum.	<i>pr.</i> spermiducal gland.
<i>coel.</i> , coelom.	<i>p. v. l. v.</i> , posterior ventral lateral vessel.
<i>d. l. v.</i> , dorsal lateral vessel.	<i>sep.</i> , septum.
<i>d. v.</i> , dorsal vessel.	<i>sp. ch.</i> , spermiducal chamber.
<i>g. p.</i> , genital papilla.	<i>sp. d.</i> , sperm-duct.
<i>g. s.</i> , genital seta.	<i>sp. th.</i> , spermatheca.
<i>g. s. gl.</i> , gland of genital seta.	<i>sp. s.</i> , sperm-sac.
<i>l. v.</i> , lateral vessel.	<i>v. n.</i> , integumental vascular network.
<i>m.</i> , muscles.	<i>v. v.</i> , ventral vessel.
<i>m. v. l. v.</i> , median ventral lateral vessel.	<i>po.</i> , spermiducal pore.

PLATE XXXIX.

Embolococephalus multisetosus.

- FIG. 1. Anterior part. × 18.
 FIG. 2. Setae. × 250.
 a and b, from ventral bundles.
 c, palmate seta from dorsal bundle.
 d, distal end of same.
 FIG. 3. Sections of sperm-duct. × 180.

Rhizodrilus lacteus.

- FIG. 4. Setae. × 250.
 a, ordinary uncinata seta.
 b, genital seta from IX.
 c, genital setae from XI.
 FIG. 5. Transverse section through spermiducal chamber. × 70.

PLATE XL.

Rhizodrilus lacteus.

- FIG. 6. Sagittal section through genital papilla, seta, and gland of IX., combined from several sections. × 180.
 FIG. 7. Transverse section through spermatheca. × 70.
 FIG. 8. Diagram of blood-vessels in VII IX.

Ilyodrilus coccineus.

- FIG. 9. Diagram of blood vessels in V VIII., adapted from a figure by Stole.

Vermicululus pilosus.

- FIG. 10. Diagram of blood-vessels in IV-VI, from a figure by Goodrich. Those of VII-X are similar.